AIRBUS A/C: capabilities considerations

NAT 2030 Vision Workshop
January 29th & 30th, 2019
Airport Navigation

Taxi & Post Flight

Pre-flight & Taxi

Take-Off & Departure

Take-Off Monitoring

Runway Incursion Alert "SURF-A"

Multi criteria Departure Procedure

Taxi Routing

Airport Navigation

Weather

Trajectory Based Operations (4D)

RNP 2

Formation Flight

Enhanced Communications

Airborne separation

ATSAW

Cont. Descent Approach

RNP-AR

Curved Approach

Increased Glide Slope/Double slope

GBAS Landing System

SBAS Landing System

Runway Overrun Prevention System

TCAS Alert Prevention

Brake to Vacate

Contaminated Runway Reporting

Braking action computation

GBAS Landing System

Enhanced Communications

Navigation on complex airports
Complex taxi route clearances (errors, misunderstanding...)

SAFETY enhancement
- Increased situation awareness
- Runway incursion risk alleviation

ATM Enhancement
- Easier taxiing

Expected Benefits

SESAR STUDY > 2020
Runway Incursion Traffic Alert

Runway incursions are a major hazard with around 1 occurrence a day in the world.

Runway Incursion Traffic Alert is a Safety net which provides both an aural alert and an intuitive visual cue in the Primary Field of View of each pilot. ADS-B In based.

Expected Benefits

- SAFETY enhancement
- ATM Enhancement

SESAR STUDY + (VERY LARGE SCALE DEMO) > 2020
Take-Off Securing (TOS)

Principle/Description

TOS checks:
- ZFW entry is part of defined range
- V1/VR/V2 values are coherent and consistent

TOS checks:
- Distance to lift-off
- A/C position compared to Runway entered in FMS

Expected Benefits

- Reduce Accidents and Incidents at Take Off
- Reduce tail strike risks
- Recognise gross errors
Multi-Criteria Departure Procedure (MCDP)

A380/350 FMS Noise Abatement function as the basis for enhanced after Take Off procedures (demo project currently running with A350 and A320)

Background

MCDP provides best vertical profile for targeted benefits (either Noise or Fuel or a trade-off)

- Integrated on EFB
- On ground to enlarge palette of functionalities

ATM Enhancement

- Fuel or noise benefits optimised procedures

Enabler for:

- Operations Efficiency
- Environmental Efficiency

Expected Benefits

MCDP UNDER STUDY
**Trajectory Based Operations - Aircraft predictions (4D)**

**Background**
- **Today:** where the aircraft is
- **Tomorrow:** where the Aircraft will be

**Increase Safety** (no uncertainty on aircraft intent)

**Reduce aircraft delays** enhanced ATC tools (better aircraft position prediction, more accurate conflict detection…)

**Reduced fuel burn**

**Provide ATC with the a/c FMS data**

**Expected Benefits**

**Principle/Description**

**VERy LARgE dEMO in 2019 (EUROPE)+ I4D MARCH 2019 (CHINA)**
Enhanced Communications

Background

- Poor HF voice + HFDL Performance
- Single Satcom at a time
- Media Transition

Expected Benefits

- Enhanced HF(DR)
- Dual Satcom (Inmarsat + Iridium Next)
- ATN over Satcom
- Safety com services over Ku/Ka IP
- ACARS over IP

Increased quality, availability and throughput
TCAS Alert Prevention (TCAP)

**Background**

Current TCAS equipment does not take into account respective aircraft altitude targets. Thus, undue “Resolution Advisory” Alert (RA) can occur on level-off situations. Level-off RA represents more than 50% of RA in European sky.

**Principle/Description**

The **TCAP function** aims at reducing the number of “abusive” TCAS RA alerts occurring during 1000ft level-off maneuvers.

As soon as a TA is triggered, the new TCAP altitude capture law modifies the vertical trajectory. RA (Resolution Advisory) is avoided.

**Expected Benefits**

- **SAFETY enhancement**
  - Suppression of undue level-off RAs
  - Crew workload alleviation
  - Less pilot stress
  - Less traffic perturbation
Airborne Traffic Situational Awareness (ADS-B IN ATSAW)

Background

ATSAW is an Airbus ADS-B IN application to enhance flight crew knowledge of the surrounding traffic. A brick to reduced separation and CDTI assisted operations.

Principle/Description

ADS-B: Automatic Dependant Surveillance – Broadcast

Transmission = ADS-B Out

Reception = ADS-B In

Expected Benefits

- Improve situation awareness
- Enhance cooperation with Air Traffic Control
- Allows for In Trail Procedure (ITP)

CDTI: Cockpit Display of Traffic Information
CDTI Assisted Visual Separations (ADS-B-IN CAVS/CAPP)

**Background**
Cleared for a visual separation the crew can monitor the relative evolution of preceding traffic (speed trend, heading, altitude).
Separation responsibility can be transferred to flight crew.

**Safety**
Reduce the number of Go-Around at congested airport by delegating to the flight crew the responsibility to maintain the separation with a traffic in-sight.

**Fuel Savings**
shorter trajectory

**Expected Benefits**

**ADS-B**: Automatic Dependant Surveillance Broadcast,
**CDTI**: Cockpit Display of Traffic Information,
**CAVS**: CDTI Assisted Visual Separation,
**CAPP**: CDTI Assisted Pilot Procedure,
**VMC**: Visual Meteorological Conditions

**ATSAW + > 2021**
Next ADS-B IN applications - Airbus road map

- Baseline foundation
- ADS-B in air
- ADS-B on ground

Certified

ATSAW

ITP

VSA

AIRB

Under study (SESAR)

2017

Prepare to CAVS
Trials on VSA

- Support to visual separation
- Capacity improvement

CAVS (ATSAW+)

Longitudinal Manual Spacing

- Flight efficiency
- Capacity improvement

2020

2018-2020

SURF-A

(Runway Incursion
Traffic Alert System)

- Potential conflict detection on ground

Certified

Continuous Descent Approach (CDA)

Background

Noise: a major obstacle to traffic growth at numerous Airports.

CDA (no level segments) reduce noise by flying higher with reduced thrust.

Principle/Description

CDA automated function:
• Deceleration while descending
• Managed descent Guidance
• Provides crew monitoring cues for energy management

Expected Benefits

Environmental Efficiency (Noise)

Fuel Savings

With Honeywell FMS

Jan 2019 NAT SPG W/S
SBAS Landing System (SLS)

CAT1

Background

- SBAS deployment: Increasing number of LPV approaches
- SBAS constellations supported: WAAS (US), EGNOS (Europe), GAGAN (India), MSAS (Japan), BeiDou (China)
- ILS cat 1 decommissioning plan replaced by LPV approaches

Principle/Description

**SLS** allows flying RNAV (GNSS) approaches with vertical guidance down to LPV minima (200 ft: CAT I equivalent) without any local ground infrastructure

Operations Efficiency

- Lower minima on RNAV(GNSS) approaches, (down to 200 ft, without any ground infrastructure)
- Approach stability (geometrical guidance)
  - No dependency to barometric settings & temperature variations
- Reduced crew training (ILS look alike concept)

Expected Benefits

- SBAS Geo satellite
- GNSS constellation

COMING MID 2020
GBAS Landing System (GLS)
CAT1 to CAT 2/3

Background

Advanced satellite navigation systems allow to overcome ILS

GBAS can support all-weather operations capability at CAT1, 2 and 3 airports for all phases of approach, landing, departure, and surface operations.

- **CAT 1**: available on all Airbus types
- **CAT 2 with CAT 1 Avionics**: on-going trials in US and Europe
- **CAT 3**: Prototypes developed – Concept mature & ready to deploy

Operations Efficiency

- Reduced infrastructure costs compared to ILS
- **Capacity**: smaller protection zones than ILS
- **Reduced crew training**: ILS look alike concept
- **Noise benefits**: Enabler for increased glide slope, double slope and displaced threshold

GLS CAT 3 > 2023
Enhanced arrival procedure enabled by GBAS

**Increased Glide Slope**
- Glide slope increased compared to conventional glide slope
- Higher aircraft trajectory → **noise benefits**

**Adaptive-Increased Glide Slope**
- Glide slope adapted to day's conditions (A/C weight, wind, ...)
- Higher aircraft trajectory → **noise benefits**

**Double Slope**
- Final approach segment split into 2 slopes
- Higher aircraft trajectory → **noise benefits** (steeper slope only)
- Conventional landing/flare manoeuvre

**Multiple Runway Aiming Point**
- Shifted final approach segment
- Higher aircraft trajectory → **noise benefits**

**Noise Benefit**
- Increased Glide Slope
- Adaptive-Increased Glide Slope
- Double Slope
- Multiple Runway Aiming Point
RNP AR: Required Navigation Performance Authorisation Required

**Background**
RNP is a Performance Based Navigation with on-board monitoring and alerting.
RNP AR needs special aircraft and flight crew authorization for more stringent operations (RNP AR 0.3 or lower in approach).

**Principle/Description**
RNP AR allows to fly more flexible approaches, missed approaches and departures.

Three levels:
- Limited to 0.3 NM for A320/A330/A340/A380
- ≤ 0.3 NM for A320/A330
- 0.1 NM for A350

**Expected Benefits**
- Accessibility of airports in mountainous areas: Final approach is no longer limited to straight-in approach aligned with the runway axis
- Optimized tracks for noise abatement
- Lower minima: Reduced margin to obstacles
- Increased payloads through lateral avoidance of obstacles
- Fuel/time savings through optimized tracks
- Increased airport capacity: simultaneous IFR approaches to close parallel runways
Curved Approach - RNP to xLS

European Implementing Regulation:
By 2024 the 25 major airports will have implemented RNP1 procedures for departures and arrivals including Radius to Fix (RF) legs.

• Combines the benefits of RNP AR with the Weather resilience of precision approach and autoland

• Same benefits of RNP AR for environmental and track miles saving aspects

RF connected to FAP

Background

Principle/Description

Expected Benefits

ICAO STANDARDISATION
ON-GOING
Braking Action Computation

**Background**

Runway Excursion is #1 Air transportation source of accident: especially on contaminated runways

Both EASA and FAA support Airbus concept definition

**Use the aircraft as a sensor for objective measure of braking action**

1. RWY State result is computed onboard the aircraft
2. Result is sent via ACARS and shared ground infrastructure
3. Runway Condition Code is disseminated by ATC to upcoming aircraft

**Expected Benefits**

**ATM Enhancement**
- Provides objective, timely and regular reports of actual contaminant effect on A/C stopping distance.
- Enables long term RWY condition monitoring (RWY performance degradation)

**Operations Efficiency**
- Enabler to better tactical decisions
- Help for pilot PIREP

**TRIALS WITH SOME AIRLINES**
- **ON-GOING**
- **MID 2019**
Brake To Vacate (BTV)

**Background**

Runway Occupancy Time (RoT) is a constraining factor for airports operating near maximum capacity. Having a means of optimizing deceleration could both reduce RoT and reduce Brake wear (cf. use of conservative braking for today operations).

**Expected Benefits**

- **Operations Efficiency & ATM Enhancement**
  - by reducing Runway Occupancy Time (RoT) at landing and making it deterministic
  - Cost Reduction for Airlines by optimizing braking energy / temp, reducing wear / improving Turn Around Time (TaT)

**Principle/Description**

BTV is an AUTO-BRAKE mode, aiming at automatically managing braking to target a selected taxiway exit:
- In flight, the pilot selects an exit taxiway through a predictive assessment of braking distance
- On ground, BTV actively adapts the braking level, delaying braking if possible, reaching the most rapidly the selected exit.
Runway Overrun Prevention System (ROPS)

Runway Excursion is #1 Air Transportation source of accident

Numerous events could be avoided by providing flight crews with relevant information to make the right decision in a timely manner.

Background

ROPS is an alerting system to prevent runway overrun.

ROPS is based on continuous real-time calculation of stopping distance vs remaining runway length. In case of RWY too short detected:

- In air, ROPS triggers a “ROW” alert to encourage the crew to make a go around.
- On ground, ROPS triggers a “ROP” alert to encourage the crew to apply and keep all available deceleration means.

Principle/Description

SAFETY enhancement
- Nearly eliminates Runway Overrun at landing
- Through clear, unambiguous visual and aural alerts with simple procedures

Cost Reduction for Airlines
- Reduces insurance premium
Questions?